Self-Organizing Networks in LTE: a Q-learning approach to ABS optimization

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***Abstract*—This is a template for a scientific research paper. The abstract is a super brief summary of what you do in the paper.**

I. Introduction

The great spreading of mobile devices all over the world represents the fastest adoption of any technology that our society has ever experienced, faster than the Internet and the earlier generations of mobile communications. Now tablets, android devices, iPhones, application stores, social media and the data exchanges between end-users and clouds are all growing at exponential speed. Providing the necessary bandwidth and capacity to the people so they can keep the pace of this growth is a fascinating challenge, then in order to achieve that, a more network densification is requested together a full exploitation of the simultaneous presence of micro (coverage radius around 10m-300m) and macro (coverage radius up to 20km) cells, the so called heterogeneous networks (HetNet).

The only way these challenges can be cost-effective, efficient and human-handleable is through the use of more automated and autonomous systems, such as Self-Organizing Networks (SON): the goal is to minimize the human intervention in the planning, deployment, optimization and maintenance activities of these new networks.

A such SON conceptually must own, as explained by [3], the following capabilities:

- Self-Planning: process of identifying the parameter settings of new network elements, including site locations and hardware configuration (like radio parameters of a new eNodeB or a table of neighbor nodes);
- Self-Deployment: preparation, installation, authentication and delivery of a status report of a new network node in order to get a "plug and play" approach for each new device;
- Self-Healing: execution of the routine actions that keep the network operational and/or prevent problems (this includes the necessary software and hardware upgrades);
- Self-Optimization is defined as the utilization of measurements and performance indicators collected by the User Equipments (UEs) and the base stations in order to autotune the network settings.

Our work is focused on the last point of the list, more precisely on the improvement of the signal quality and consequently the throughput in a LTE system, trying to minimize the interference between micro and macro cell with an adaptive coordination in downlink transmissions of the antennas (mainly controlling the transmit power patterns).

The problem we're facing consists in discovering an optimal trade-off of the radio resources to be assigned between high-power nodes (macro) and low-power nodes (micro). The latter has an higher capacity and consequently an user connected to it will benefit of a better performance, however due to fact that it shares the same frequency band with the macros, low-power nodes are severely affected by the interference from the high-power nodes. In other words, downlink micro transmissions to its UEs could be sorely degraded by high power macro transmission; besides UEs that are close to a micro could end up associating to a macro due to the higher power strength received from the stronger node.

So the issue is that, accounting the above scenarios, the micro could be left underutilized and this would turn out to be a bad exploitation of the resources deployed appositely to enhance the connectivity in some areas alongside an important decrease of the user performance in comparison with achievable potential capacity.

Then with the purpose of promote fair sharing of the resources, we decided to address the problem trying to stopmacros from the transmission almost completely (some signals, like beacons, are always active), for a certain amount of subframes in a frame: this approach is already adopted by LTE and is known as enhanced inter cell interference (eICIC),

The introduction is structured as follows

- **What are we talking about: description of the addressed problem.**
- **Motivation: why the problem is important.**
- **Novelty: how you contribute to advance the state of the art**
- **Results: summary of the main findings**

II. Related Work

The Related Work section contains an analysis of the most relevant related literature (remarking the shortcomings that are addressed in your work)

III. System Model

In order to evaluate the proposed algorithm we carried out extensive MATLAB simulations using MONSTeR (MObile Networks SimulaToR).

IV. Results

The Results section contains a selection of the most relevant results with the explanation of their meaning. Please, not that you do NOT have to describe the shape of the curves that can be seen in the figures, but the reasons WHY such curves have that shape!

V. Conclusions

Conclusions are a superbrief summary of what has been done and highlighting of the "take home message"

References

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